

# **ANALYZING INTERNATIONAL ECONOMIC INFLUENCE ON IRAN**

**A Monograph**

**by**

**Lt Col Robert S. Renfro, II, Ph.D., USAF**

**United States Air Force**



**School of Advanced Military Studies  
United States Army Command and General Staff College  
Fort Leavenworth, Kansas**

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Lt Col Robert S. Renfro, II, Ph.D., USAF

ANALYZING INTERNATIONAL ECONOMIC INFLUENCE ON IRAN

This monograph was defended by the degree candidate on 7 October 2009 and approved by the monograph director and reader named below.

Approved by:

_____	Monograph Director
David A. Anderson, DBA	

_____	Director, School of Advanced Military Studies
Stefan J. Banach, COL, IN	

_____	Director, Graduate Degree Programs
Robert F. Baumann, Ph.D.	

## **Abstract**

ANALYZING INTERNATIONAL ECONOMIC INFLUENCE ON IRAN by Lt Col Robert S. Renfro, II, Ph.D., USAF, 52 pages.

The interconnectedness of global trade influences international relations. The complexities of this interconnectedness may be better understood through quantitative analysis of the balance of trade within the global economic system. This monograph serves as a proof-of-concept testing analytic tools for better understanding the efficacy and consequences of economic influence in terms of sanctions and other similar macroeconomic regimes. The underlying concept developed is a calculation of economic threat rings describing the propensity and utility of countries to participate in such regimes. Iran is used as a case study as it has a long standing record of sanctions being imposed upon it by the United States and others since its 1979 revolution. Iran continues to be of contemporary interest in American foreign policy owing to concerns with respect to its known sponsorship of terrorism and suspected pursuit of nuclear weapons.

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## Introduction

The interconnectedness of global trade influences international relations. The complexities of this interconnectedness may be better understood through quantitative analysis of the balance of trade within the global economic system. Economics is an instrument of national power affecting international relations. Transnational trade relationships offer both risk and opportunity in the pursuit of national objectives. Globalization has increased the interconnectedness of national economies around the world. This interconnectedness potentially enables international coalition building based upon common economic interest. Likewise, such interconnectedness potentially deters, moderates, and constrains nations from actions, which would negatively affect their economy. Analysis of such relationships presents decision makers both risk and opportunities in terms of international support, influence and the potential success of economic coercion.

This monograph serves as a proof-of-concept testing analytic tools for better understanding the efficacy and consequences of economic influence in terms of sanctions and other similar macroeconomic regimes. The underlying concept developed is a calculation of *economic threat rings* describing the propensity and utility of countries to participate in such regimes. Economic threat rings are bounded by the distance across each of the dimensions of international trade between the country imposing sanctions and the targeted country. For any given set of countries, the economies of countries inside the ring are more at risk to sanctions than those outside the ring. Any countries inside the ring are, therefore, rationally less likely to support such sanctions. The existence of national economies inside such rings shows that sanctions are an imprecise weapon.



Sanctions necessarily require countries other than the targeted country to accept losses in the global economy in order for sanctions to be effective. When such losses are suffered by countries un-desirous of supporting sanctions for political, economic or other reasons then the prospect for influencing the targeted country is reduced.

In this monograph the economic threat ring technique is applied to the case of modern day Iran. Iran is used as a case study as it has a long standing record of sanctions being imposed upon it by the United States and others since its 1979 revolution. Iran continues to be of contemporary interest in American foreign policy owing to concerns with respect to its known sponsorship of terrorism and suspected pursuit of nuclear weapons. Based on analysis of the results, conclusions are drawn with respect to the risk opportunities present to American decision makers in terms of international support and the potential success of economic coercion targeted against Iran. Statistical analysis of publicly available balance of trade data for Iran and its interconnected network of related global trading partners are central to this study.

## **Defining and Classifying the Problem**

The history of both unilateral and multilateral sanctions is one wrought with very limited success in modifying the behavior of targeted countries. Countries such as Cuba, Sudan, Libya, North Korea, Iraq and Iran have faced sanctions for decades.<sup>1</sup> In Cuba, the Castro government has maintained power and sustained its repressive regime off the coast of the United States even after the fall of the Soviet Union in 1989. Sudan has continued to this day to be a safe-haven for terrorism and criminals while engaging in government sponsored genocide in Darfur. Libya has exhibited some behavioral change

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<sup>1</sup> Megan L. O'Sullivan, *Shrewd Sanctions*, (Washington, D.C.: Brookings Institute Press 2003), 1-2.

relative to its sponsorship of global terrorism; however, not until after air strikes by American forces. North Korea developed nuclear weapons under sanctions. In retrospect, we now know that Iraq may have essentially complied with sanctions following the Gulf War; however, their behavior and rhetoric still led to violent conflict in the form of Operation Iraqi Freedom. Iran continues to be a sponsor of terrorism, particularly Hezbollah, and is suspected to be developing nuclear weapons in its nuclear energy program. Iran has continuously obstructed oversight of its nuclear program by international organizations such as the International Atomic Energy Agency.

This brief history of sanctions shows that the prospect for successful sanctions is grim; however, these examples do not answer the question of why sanctions are generally ineffective. Most importantly it is necessary to understand the complexity of the global economic system. By understanding the complexity of this system, it is then possible to select analytical techniques which are best suited to its examination. Having identified such techniques it is then possible to evaluate relationships in the global economic system and quantify the economic risk to countries considering participation in sanctions upon any other country.

It should also be noted that sanctions are generally not applied to all commodities in the global economic system. Frequently, medical and food aid and trade are excluded from sanctions for humanitarian reasons.<sup>2</sup> Such exclusions will be detailed later in this monograph using a case study of Iran. In general, however, this means that the degree to which sanctions affect a sanctioning country as well as the sanctioned country depends on the type of commodities which are involved in their respective trade arrangements.

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<sup>2</sup> United States Department of State, "U.S.-Iranian Relations," (accessed September 9, 2009); Available from <http://www.state.gov/r/pa/ei/bgn/5314.htm#relations>; Internet.

The commodity based perspective of sanctions adds to the complexity of global economic trade.

While it is commonly accepted that global trade is a complex system, there is utility in formally defining the nature of its complexity. There are many models available to describe complex problems. This monograph applies the model defined by Axelrod in his book *Harnessing Complexity*. The reason Axelrod's model was selected is that his goal is not simply to describe complexity, but rather go further into understanding opportunities to take advantage of complexity. In the context of this research, Axelrod's model helps to clearly articulate the class of problem presented by economic coercion on a transnational scale which then enables the selection of appropriate methods to examine such problems.

Axelrod defines a complex system using the following model.<sup>3</sup> Complex systems, such as global trade, involve a large number of *agents* (or countries in this study). Agents form a *population*; in this study the population shall be the countries found relevant to understanding Iranian trade relations relative to international economic coercion. Material resources used by agents are known as *artifacts* which are trade goods in this study. And, patterned behavior by agents is known as a *strategy*, or patterns of trade in this study, which are based on bilateral and multilateral agreements as well as market forces. All of these elements form a *system*, in this case the global economic system.

This system, using Axelrod's model, is particularly complex owing to the number and diversity of interactions between agents. It is bounded by geography (or what

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<sup>3</sup> Robert Axelrod and Michael D. Cohen, *Harnessing Complexity* (New York: Basic Books, 2000), 153.

Axelrod calls *physical space*) as well as trading blocs, agreements and other non-physical influences (which Axelrod calls *conceptual space*). Economic coercion relates directly to modifying what Axelrod calls *selection*, related to the frequency with which agents implement certain strategies relative to other agents or types of agents. Strategies, for example, may include most favored nation trade status (reward) as well as sanctions, boycotts and blockades (coercion). And, finally, Axelrod argues that agents employ *success criterion*. While success criterion related to global trade generally may include increased trade revenue, Foreign Direct Investment, growth in Gross Domestic Product and so on; in this study, the criteria shall be the degree to which the ends of economic coercion strategies are realized. So, for example, if the reason sanctions are applied economically is human rights, proliferation of weapons mass destruction and/or other such issues; then success should be measured in terms of positive change on these issues from the perspective of the country(s) engaging in economic coercion.

Formally defining international trade as a complex system and economic coercion as a bridge between international relations and economic strategies of countries adds context to this problem. More importantly, it describes the class of problem studied in this monograph and as a direct consequence the class of solution techniques which are applicable to the analysis of this problem. Multi-Dimensional Scaling (MDS), described in the methodology section of this monograph, is a solution technique well suited to complex problems where the underlying patterns of behavior are both complex and ambiguous.

## Methodology

Economic threat ring analysis, as described in the introduction and detailed in this section, forms the basis of the methodology and is applied as a proof-of-concept to the case of present day Iran. Economic threat rings shall be calculated using non-metric Multi-Dimensional Scaling (MDS) of the respective imports and exports between countries directly and indirectly connected to trade with Iran. MDS was selected for this study because it is a technique which yields a graphic representation of the proportional closeness and relative orientation of objects (countries in this study) based on data where understanding the underlying dimensionality is complex and ambiguous (global trade and its relationship to international relations in this study). Non-metric MDS is necessary as trade relationships are not expected to generally be symmetric in nature (symmetry is a necessary condition of a metric space). MDS results consist of a two-dimensional projection for each dimension found statistically significant in the underlying data. Each dimension corresponds to a mathematically unique aspect of the data under investigation. MDS does not and cannot explain or label what these aspects are in a non-mathematical context. Therefore, relationships found of interest in MDS results must be explored through additional research in terms of the context (international trade in this study) to determine the practical nature of the relationship if it is to be known.

To analyze US sanctions on Iran, economic threat rings in this study are drawn with Iran at the center and the radius defined by the distance between Iran and the United States for each dimension of the trade relationship found statistically significant in the MDS analysis. The radius of this ring represents the degree to which the United States is connected to Iran's economy both directly and indirectly. Countries inside the ring have

greater economic connectedness than the United States for a given dimension making them simultaneously more capable and less likely to participate in coercive economic actions owing to the potential impact on their own economy. Countries outside of the ring have less economic connectedness than the United States making them simultaneously less capable and more likely to participate in coercive economic actions. Likewise, leaders of countries inside the ring are accepting greater political risk than those outside of the ring relative to the risk American leaders are accepting.

Risk in this context has two main components which are interconnected. First, there is economic risk. Economic risk is the quantifiable potential for losses to the economy of countries imposing sanctions. This includes losses as a direct result of imports and exports to or from the sanctioned country as well as losses from lessened supply and demand in other countries commonly trading with sanctioned country. Second, and closely tied to economic risk, is political risk. Leaders who make decisions, perhaps for ideological motivations or reasons related to foreign relations, which cause damage to the economic health of their own country risk their ability to maintain power. Depending on the political systems and traditions of such countries, they risk anything from losing reelection to civil unrest and insurrection.

The paradox between capability and likelihood shall be examined in terms of opportunities and risk. The results of this examination are then qualitatively compared to positions, strategies, and actions taken by statistically significant countries with respect to Iran. The correlation between the analysis of statistical results and respective national policies and behaviors shall serve as evidence either confirming or denying the

hypothesis that trade relationships constrain international relations within the scope of this study.

It should be noted that there is an inherent potential bias in this analysis of balance of trade data as for any given year the effects of such sanctions both explicit and implicit may be causal in the relations described by such economic threat rings. Explicitly, as will be discussed later, many countries choose largely not to participate in US sanctions on Iran making them nearly unilateral in nature. This adds some degree of confidence to the selection of Iran as a case study; however, the implicit resulting hostility towards Iran by countries friendly to the United States is more difficult to estimate. As data regarding such implicit influence on decision making is difficult if not impossible to collect, this effect shall be treated as a source of potential error rather than as an explicit factor in quantitative analysis.

Multidimensional Scaling (MDS) “provides a visual representation of the pattern of proximities (i.e., similarities or distances) among a set of objects.”<sup>4</sup> If  $N$  is the number of countries studied, MDS requires an  $N \times N$  matrix,  $A$ , with elements  $a_{ij}$  representing trade between countries  $i$  and  $j$  in  $N$ .<sup>5</sup> This matrix is called the *similarity matrix*.<sup>6</sup>

MDS also requires a stress function that measures “the degree of correspondence between distances [or similarities].”<sup>7</sup> The *Kruskal* stress function is commonly used in

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<sup>4</sup> Stephen P. Borgatti, and others, *UCINET 5.0 for Windows User's Guide, Version 1.00* (Natick: Analytic Technologies, 1999): 29.

<sup>5</sup> Borgatti, 78.

<sup>6</sup> Borgatti, 78.

<sup>7</sup> Borgatti, 32.

MDS and defined as:  $((\sum_i \sum_j a_{ij} - d_{ij}) / (\sum_i \sum_j d_{ij}^2))^{1/2}$  where  $d_{ij}$  is the Euclidean distance between points  $i$  and  $j$  based on the coordinates assigned in the following algorithm.<sup>8</sup>

1. Assign points [nations] to arbitrary coordinates in  $p$ -dimensional space. The initial selection of  $p$  is made by the analyst and is somewhat arbitrary as it will be varied in response to the results of this iterative procedure.

2. Compute the Euclidean distances between all pairs of points, to form what is called the  $D$  matrix.

3. Compare the  $D$  matrix with a monotonic function  $[f(a_{ij})]$  of the input data [the metric *Kruskal* stress function defines  $f(a_{ij}) = a_{ij}$ ], called *DHAT*, by evaluating the stress function. A smaller value indicates greater correspondence between the  $D$  matrix and the *DHAT* matrix.

4. Adjust coordinates of each point in the direction that maximally reduces stress by increasing or decreasing  $p$ , the dimensionality of the space.

5. Repeat step 2 through 4 until stress will not get any lower or acceptable bounds on stress are achieved.

Using the above MDS algorithm, it is possible to graphically plot the coordinates of nations in the global economy for every two dimensional projection of distance.

Those nations that are closer to each other are, based on the theory of this technique, closer economically in the context of the measure applied. Borgatti notes that, “the best possible configuration in two dimensions may be a very poor, highly distorted, representation of your data. If so, this will be reflected in a high stress value.”<sup>9</sup> Any stress value greater than zero indicates that the representation of relationships is distorted.

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<sup>8</sup> Borgatti, 32.

<sup>9</sup> Borgatti, 31.



Stress in the MDS model implies a lack of fit to the underlying data.<sup>10</sup> As a perfect fit to real world data is naturally unlikely owing to error and mathematical artificialities, MDS methods involve selecting bounds on stress. These thresholds mean that unless the number of dimensions is known with certainty and data is collected without error, stress must exist in the final MDS solution.

Borgatti suggests that even in the presence of stress, “you can rely on the larger distances as being accurate.”<sup>11</sup> Borgatti also maintains that the axes and the orientation of the MDS plot are “meaningless” as there may be multiple orientations that have the same minimum stress and the axes are only proportional in nature.<sup>12</sup>

MDS lacks detail with respect to what the dimensions actually represent. Two approaches are suggested for labeling the resulting MDS dimensions (axes in a graphical representation): (1) “subjective” and (2) “objective” procedures.<sup>13</sup> Subjective procedures involve using judgment to label dimensions by visual inspection.<sup>14</sup> “There is no attempt to quantitatively link the dimensions to attributes [of the data].”<sup>15</sup> The objective procedure “collects attribute ratings [criteria] for each object and then finds the best correspondence of each attribute to the derived perceptual space [MDS coordinates].”<sup>16</sup> In this approach multiple attributes are assigned to each axis based on which axis represents the greatest weighting of particular attributes; however, aspects of the

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<sup>10</sup> Borgatti, 33.

<sup>11</sup> Borgatti, 35.

<sup>12</sup> Borgatti, 35.

<sup>13</sup> Rolph Anderson, and others, *Multivariate Data Analysis*, 3<sup>rd</sup> Ed., (New York: Macmillan Publishing Co., 1992), 330.

<sup>14</sup> Anderson, 330.

<sup>15</sup> Anderson, 330.

<sup>16</sup> Anderson, 330.

attributes are still manifested in other dimensions as well.<sup>17</sup> Neither of these approaches results in an unambiguous specification of the data and attributes.

In this study it is necessary to use non-metric MDS techniques. Global trade relationships are non-metric as such relationships cannot be assumed to meet the assumptions of a metric space described below. Conceptually, these mathematical assumptions relate to the balance of trade. Only perfectly and consistently balanced trade relationships would be metric in nature. This condition cannot be assumed nor is it demonstrated in the empirical data used later in this study for the case of Iran. The only major difference between metric and non-metric MDS techniques is that the stress function is a mathematical approximation of Euclidean distance reducing the meaningfulness of the resulting distances. Greater and lesser distances using non-metric MDS techniques may not be understood using an absolute scale.<sup>18</sup>

When the “properties of distance [trade in this case] are studied abstractly they lead to the concept of a metric space.”<sup>19</sup> In general, a *metric*  $d(x,y)$  (such as trade volume between countries) is defined in terms of a metric space as follows: a *metric space* is a nonempty set  $N$  of objects (countries) together with a function (trade)  $d$  from  $N \times N$  to  $R$ , the set of real numbers, (called the *metric of the space*) satisfying the following four properties  $\forall x, y, z \text{ countries} \in N$  (the sample of countries under investigation):

$d(x,x) = 0$ , meaning countries do not trade with themselves;

$d(x,y) > 0$  if  $x \neq y$ , exports from one country to another are positive values;

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<sup>17</sup> Anderson, 330.

<sup>18</sup> Borgatti, 19.

<sup>19</sup> Tom M. Apostol, *Mathematical Analysis*, (Reading: Addison-Wesley Publishing Company, 1974), 60.

$d(x,y) = d(y,x)$ , exports equal imports between all countries;  
 $d(x,y) \geq d(x,z) + d(z,y)$ , bilateral trade relations dominate triangular (or multilateral) trade relations.<sup>20</sup>

It can logically be assumed that by definition countries do not trade with themselves and trade may be modeled such that it is represented only by positive numbers (such as its value in consistent year dollars). It cannot, however, be assumed that imports and exports are equal between all (or even any) countries and it cannot be assumed that bilateral trade relations dominate multilateral trade relationships. There are a number of formal and informal trading blocs as well as market forces influencing these relationships.

This study examines both import and export data for selected countries related both directly and indirectly to Iranian trade. Data selected for use is the percentage of a country's imports and exports to or from another country bilaterally. Percentages are used as the monetary value of trade varies drastically depending on the countries examined; however, percentages are understood to represent the relative significance of the bilateral trade relationship to a country's economy. Separate datasets were developed for imports and exports, respectively.

In examining data available from the Central Intelligence Agency's (CIA) *World Factbook*, United Nations (UN), International Monetary Fund (IMF), World Bank (WB) and World Trade Organization (WTO); the CIA's data was found to be best structured for

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<sup>20</sup> Apostol, 60.

this purpose.<sup>21,22,23,24,25,26</sup> In all of these databases, the most current, complete dataset was for the calendar year 2007.

For these reasons, CIA *World Factbook* data for the year 2007 was used in this study. It should also be noted that CIA *World Factbook* data is derived in whole or in part, depending on the country, from these and other databases. Data from 2007 may be considered contemporary for the purposes of this study as the emphasis of this research rests upon understanding patterns and flows more so than specific account balances. Additionally, as already noted, MDS results shall be on a relative scale owing to non-metric input data; therefore, rough order of magnitude in trade patterns is sufficient as input. Analysis of the MDS results will use the most current data and sources available specific to understanding conclusions of interest. This explanatory material shall also be used to confirm whether the identified results agree with current and near-term expected behavior.

The development of both the import and export databases used in this study was conducted in a similar manner. First, Iran's most significant trading partners were

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<sup>21</sup> Central Intelligence Agency, "The World Factbook: Imports – Partners," (accessed June 12, 2009); available from <https://www.cia.gov/library/publications/the-world-factbook/fields/2061.html?countryName=Iran&countryCode=IR&regionCode=me&#IR>; Internet.

<sup>22</sup> Central Intelligence Agency, "The World Factbook: Exports – Partners," (accessed June 12, 2009); available from <https://www.cia.gov/library/publications/the-world-factbook/fields/2050.html?countryName=Iran&countryCode=IR&regionCode=me&#IR>; Internet.

<sup>23</sup> United Nations, "United Nations Commodity Trade Statistics Database," (accessed June 12, 2009); available from <http://comtrade.un.org/>; Internet.

<sup>24</sup> International Monetary Fund, "World Economic Outlook Databases," (accessed June 12, 2009); available from <http://www.imf.org/external/ns/cs.aspx?id=28>; Internet.

<sup>25</sup> World Bank, "World Development Indicators," (accessed June 12, 2009); available from <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20398986~menuPK:64133163~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>; Internet.

<sup>26</sup> World Trade Organization, "Statistics Database," available from <http://stat.wto.org/Home/WSDBHome.aspx?Language=E>; Internet; accessed 12 Jun 2009.

included. Iran's major export partners are China, Japan, Turkey, South Korea, and Italy.<sup>27</sup> Iran's major import partners are China, Germany, United Arab Emirates, South Korea, Russia, and Italy.<sup>28</sup> Second, the major trading partners of these countries were included. These secondary relationships are included to capture potential triangular trade relationships where goods are transshipped via an intermediate country. Such triangular trade is both a common practice in international trade as well as a means of avoiding trade barriers, sanctions and other coercive economic measures.

Third, conscious effort was made to include the five permanent members (P-5) of the United Nations Security Council (UNSC), the Group of 8 (G8), and members and observers of the Shanghai Cooperation Organization (SCO). The P-5 (China, France, Russia, United Kingdom, and United States) were included as the P-5 are the key decision makers in the application of international sanctions and other similar coercive measures. The G8 (Canada, France, Germany, Italy, Japan, Russia, United Kingdom, and United States) was included as this organization represents leading global economies. Note that the G8 includes the Group of 7 (G7) with the addition of Russia. Members and observers of the SCO (China, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Uzbekistan, India, Iran, Mongolia, and Pakistan) were included as the SCO represents opportunity for Iran to avoid Western coercion by looking Eastward and because Iran presently has observer status in this economic and security cooperation organization.<sup>29</sup> In cases where countries are members of more than one of these categories or organizations, that country

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<sup>27</sup> Central Intelligence Agency, "The World Factbook: Exports – Partners."

<sup>28</sup> Central Intelligence Agency, "The World Factbook: Imports – Partners."

<sup>29</sup> Shanghai Cooperation Organization, (accessed June 12, 2009); available from <http://www.sectSCO.org/EN/>; Internet.

is only represented once in the respective dataset. Fourth, any remaining major trading partners of any of the countries included thus far and cited in the CIA data were included for completeness.

Larger organizations such as the European Union (EU), Organization of Petroleum Exporting Countries (OPEC), WTO, UN, and so on were not explicitly included as the resultant dataset would be extravagantly large and not necessarily strongly tied to the economic coercion of the Iran. Relevant countries included in the data used here, however, are members of some or all of these larger organizations. Therefore, the role of these larger organizations as applied to the case of Iran, while not explicitly included in the data, is included implicitly in the data and shall be discussed in terms of analysis and conclusions with respect to this data.

This selection process resulted in a total of 35 countries in the imports dataset and 37 countries in the exports dataset. Datasets, including lists of countries and their respective trade data, are provided in Appendix B. Countries are listed by their two letter country code defined by the International Organization for Standardization and found in Appendix A.<sup>30</sup> Note that totals of the percentages in the datasets need not necessarily sum to 100% owing to the selection process described above. While the datasets are somewhat sparse, they are a non-random sample representing a population bounded only by the selection process defined above. Both datasets are of sufficient size to conduct statistical analysis with respect to this case study of Iran.

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<sup>30</sup> International Organization for Standardization, “English country names and code elements,” (accessed June 12, 2009); available from [http://www.iso.org/iso/english\\_country\\_names\\_and\\_code\\_elements](http://www.iso.org/iso/english_country_names_and_code_elements); Internet.

As previously noted, these datasets do not contain factors indicating past or present participation, explicit or implicit, in economic coercion of Iran. Future studies expanding this methodology beyond a proof-of-concept should consider time series analysis of available data spanning the period prior to the application of sanctions to the present. For this case study, such effects are treated as a potential source of error analytically and shall be addressed in the contextual analysis of results with respect to the policy position of countries and organizations found significant in the following analysis. Such analysis is not needed to test whether economic threat rings as defined in this study have a correlation to related international policy towards Iran. Such further analysis would only be required for detailed analysis of the efficacy of such policies over time which is beyond the scope of this research.

## **Analysis**

Using the import and export data described above it is possible to apply non-metric MDS to these samples. As noted in the methodology discussion, it is necessary to select bounds on stress when using MDS. The goal selected for this study is to reduce the stress to at or below 0.10 (or 10%). This level of stress represents 10% or less distortion of the underlying data. Stress is reduced by increasing the dimensionality,  $p$ , in the MDS algorithm. As the input and export data is already single dimensional, the options for  $p$  start at 2 and would never be greater than the total number of countries,  $N$ , in the dataset.

Stress levels as dimensionality increases for the import and export datasets are provided below. Stress was calculated by entering the matrix datasets for imports and

exports into the software package UCINET and running the non-metric MDS algorithm while sequentially increasing the dimensionality from 2 to 10 dimensions.<sup>31</sup>

<u>Dimensions</u>	<u>Exports</u>	<u>Imports</u>
2	0.099	0.110
3	0.066	0.076
4	0.050	0.048
5	0.030	0.035
6	0.023	0.025
7	0.016	0.018
8	0.009	0.013
9	0.004	0.009
10	0.003	0.007

**Table 1. MDS Stress Results for Exports and Imports**

From this data, it can be observed that the exports dataset performed slightly better than the imports dataset in terms of stress. This is most likely owing to the fact that the exports dataset is slightly larger than the imports dataset and, thus, has more information regarding the underlying system. To confirm empirically that the underlying data is non-metric, metric MDS was run on both datasets. Even at 10 dimensions, the stress for the exports dataset was 0.131 and the stress for the imports dataset was 0.133. Both of these stress levels are above the threshold selected for this

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<sup>31</sup> Stephen Borgatti, and others, *UCINET for Windows: Software for Social Network Analysis* (Harvard, MA: Analytic Technologies, 2002).



study of 0.10 and high dimensionally with high stress is an indicator of non-metric underlying data (i.e., significant lack of fit to a *metric space* as previously defined).

To conduct further analysis, it is necessary to determine which dimensional representation to use. Stress is reduced mathematically as the dimensionality increases. This may represent properties of the data, may be artificial, or a combination of both. Therefore, a theoretical rather than mathematical reason should be the basis for this decision. For example, if the data we were studying were known to be the physical volume of rectangular buildings, then we would know that the expected dimensionality is three (representing some projection of length, width and height).

In this problem we do not know with certainty the underlying dimensionality. In this study, we will use the three dimensional representation for a number of reasons. First, triangular trade, as already described, is common and such trade would have at least three dimensions. Second, the stress for both imports and exports in three dimensions is well below 0.10 indicating very little distortion. Third, the same dimensionality should be used for both imports and exports as one country's exports are another country's imports and vice versa. Fourth, this selection is conservative in terms of mitigating any mathematical artificiality in the results caused by over specifying the dimensionality. Fifth, while it will require three two-dimensional graphs per dataset, it is possible to visually assess the resulting graphical representations of the three dimensional solutions, which is consistent with the methodology used in this study.

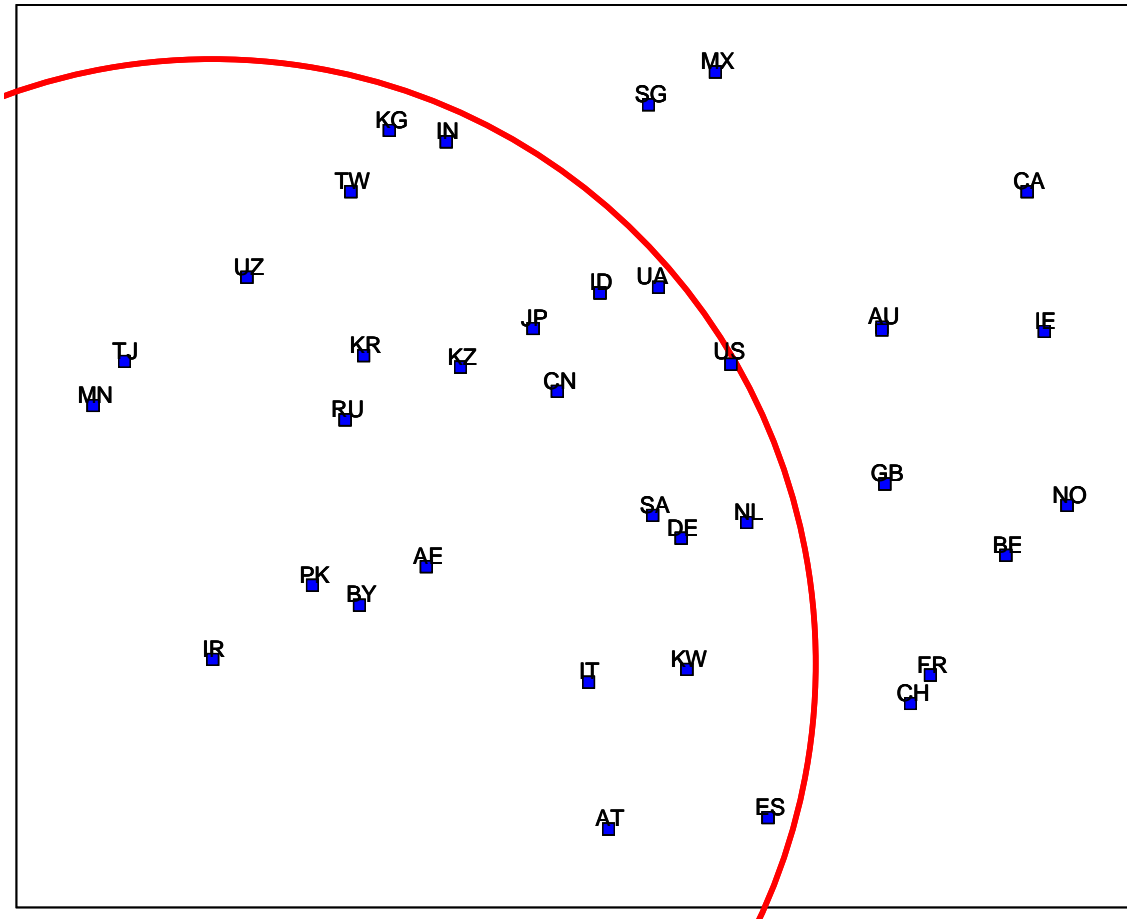
## **Iranian Imports**

Now that the three dimensional solution has been identified as the most appropriate for use in this study, it is necessary to produce the mappings of the imports

and exports by country and overlay the economic threat rings as previously defined extending from Iran to the United States in each of the two dimensional projections of the data.

The following three graphs represent the imports dataset where proximity of one country to another in each dimension is related to similarities in its import trade relationships with other countries. Note that these similarities result from the complex interactions of bilateral trade relationships as a percentage of the volume of trade related to the countries total trade. This nuance allows for a much more robust analysis of economic influence than merely examining the first order bilateral relationships between countries and their closest trading partners.

The axes are unitless in these graphs as the distance has no absolute scale and relative closeness of one country to another should only be interpreted in a context relative to the closeness of other countries in the graph. The orientation of the graph has no significance and any rotation of the graph is equally valuable as it is a conceptual representation of the data rather than a physical representation. As discussed previously, economic threat rings were overlaid on top of the MDS graphs by centering a circle on Iran (IR) with a radius equal to the distance from Iran to the US.



**Figure 1. First and second dimension of imports data**

In the two dimensional projection in Figure 1, it can be observed that the majority of the countries in the data have closer ties to Iran (IR) than the United States (US). Additionally, Iran appears to be relatively isolated from most countries and particularly western powers. The closest countries to Iran are Pakistan (PK), Belarus (BY), and United Arab Emirates (AE). Iran imports 9.1% of its total imports from the United Arab Emirates; however, has no significant imports from Pakistan or Belarus in the underlying data.<sup>32</sup> Pakistan’s closeness can be explained as it exports 10.4% of its total exports to

<sup>32</sup> Central Intelligence Agency, “The World Factbook: Imports – Partners.”

the United Arab Emirates.<sup>33</sup> The relationship to Belarus is even more complex to understand and can be explained by its close trading ties with both Germany and Russia, as Germany accounts for 9.6% and Russia for 5.7% of Iran's total imports.<sup>34</sup> Germany (DE), Russia (RU) and Italy (IT), who all account for significant percentages of Iran's total imports, are next in terms of closeness along with Saudi Arabia (SA). The position of Saudi Arabia can be explained by its strong relationship with the United Arab Emirates.

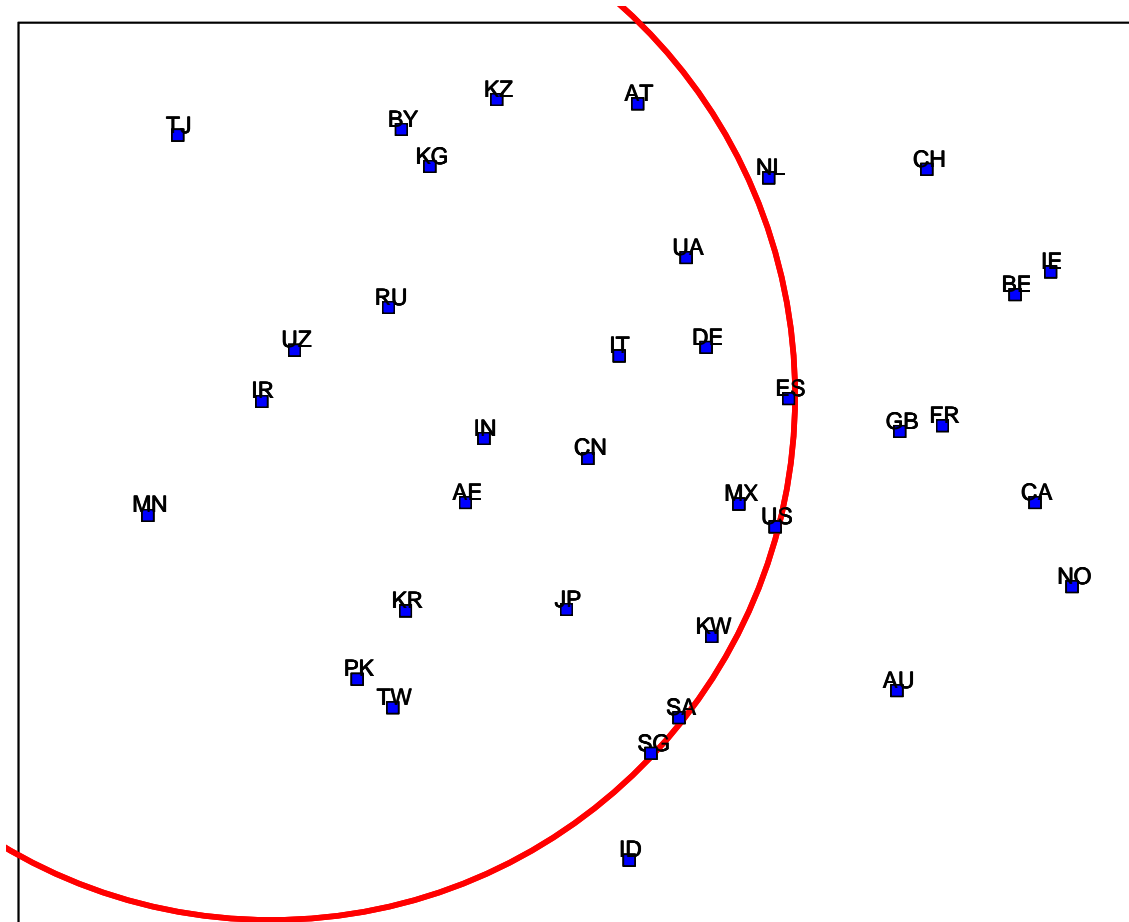
Conducting this type of analysis for every two dimensional projection of both datasets will allow for the identification of the key actors in terms of economic influence on Iran. As expected and based on the theoretical foundation of this methodology, it is possible to visualize the relative significance of triangular and other complex trade patterns between countries. This more robust understanding of economic interest provides a clearer picture of economies at risk in terms of coercing Iran.

To complete our examination of the MDS results from the imports dataset, similar analysis of the remaining two projections are required. Next, the projection of the first and third dimensions are considered.

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<sup>33</sup> Central Intelligence Agency, "The World Factbook: Exports – Partners."

<sup>34</sup> Central Intelligence Agency, "The World Factbook: Imports – Partners."



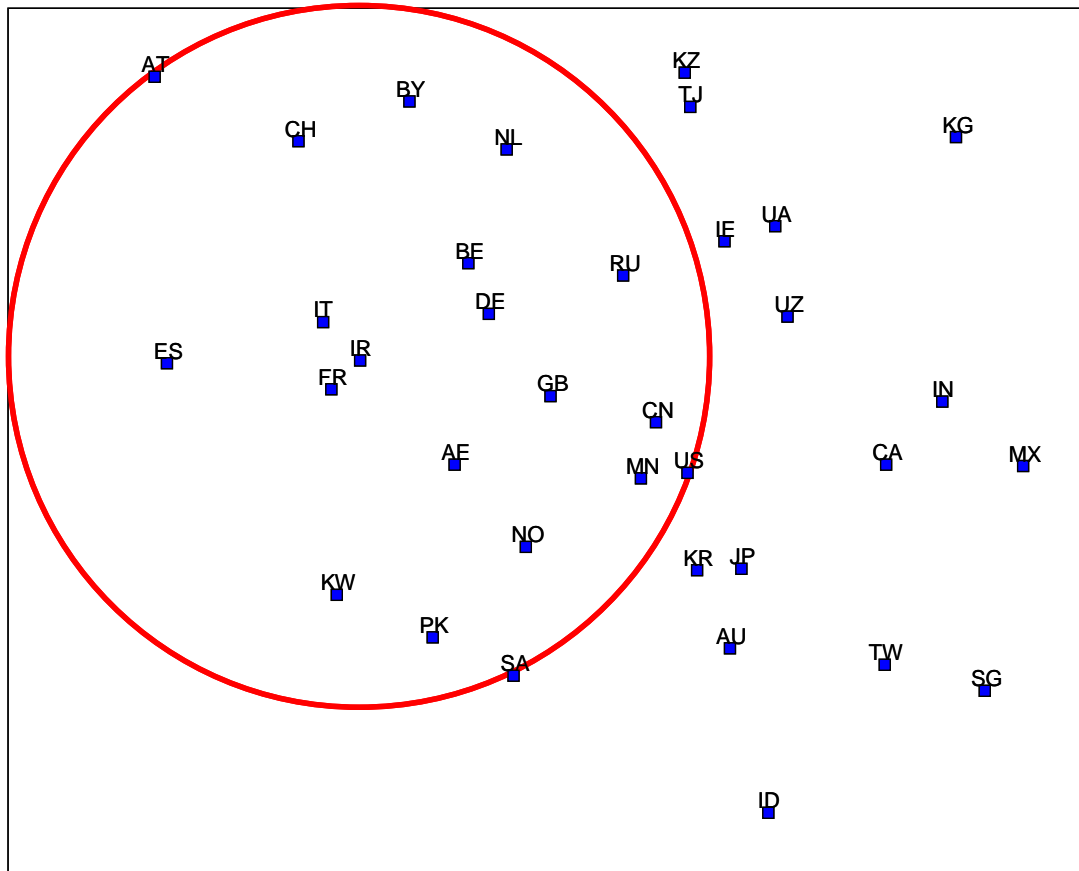
**Figure 2. First and third dimension of imports data**

In Figure 2, as in Figure 1, the relationship between the US and Iran is distant. In this projection, Uzbekistan (UZ) is the closest to Iran. This can be explained by both Iran's and Uzbekistan's close trading ties to Russia noting Russia's proximity to both Iran and Uzbekistan in the graph.<sup>35</sup> Notably, other members and observers in the SCO next surround Iran. From the top right around to the bottom right are: Tajikistan (TJ), Kazakhstan (KZ), Kyrgystan (KG), India (IN), China (CN), Pakistan (PK), and Mongolia (MN). At about the same distance, as the SCO members and observers, and similar to Figure 1, are Belarus and United Arab Emirates. In this projection, Iran's major trading

<sup>35</sup> Central Intelligence Agency, "The World Factbook: Imports – Partners."

partner South Korea (KR), accounting for 6.3% of Iran’s total imports, also appears at about the same distance as the SCO members and observers.<sup>36</sup>

For completeness, the final graph to analyze in terms of imports depicts the second and third dimensions.



**Figure 3. Second and third dimension of imports data**

Figure 3, like Figure 1 and 2, again shows the significant distance between the United States and Iran; however, unlike previous projections demonstrates ties to EU countries, particularly Italy (IT) and France (FR) and to a lesser degree Spain (ES), Belgium (BE), Germany (DE) and the United Kingdom (GB). Even the Netherlands

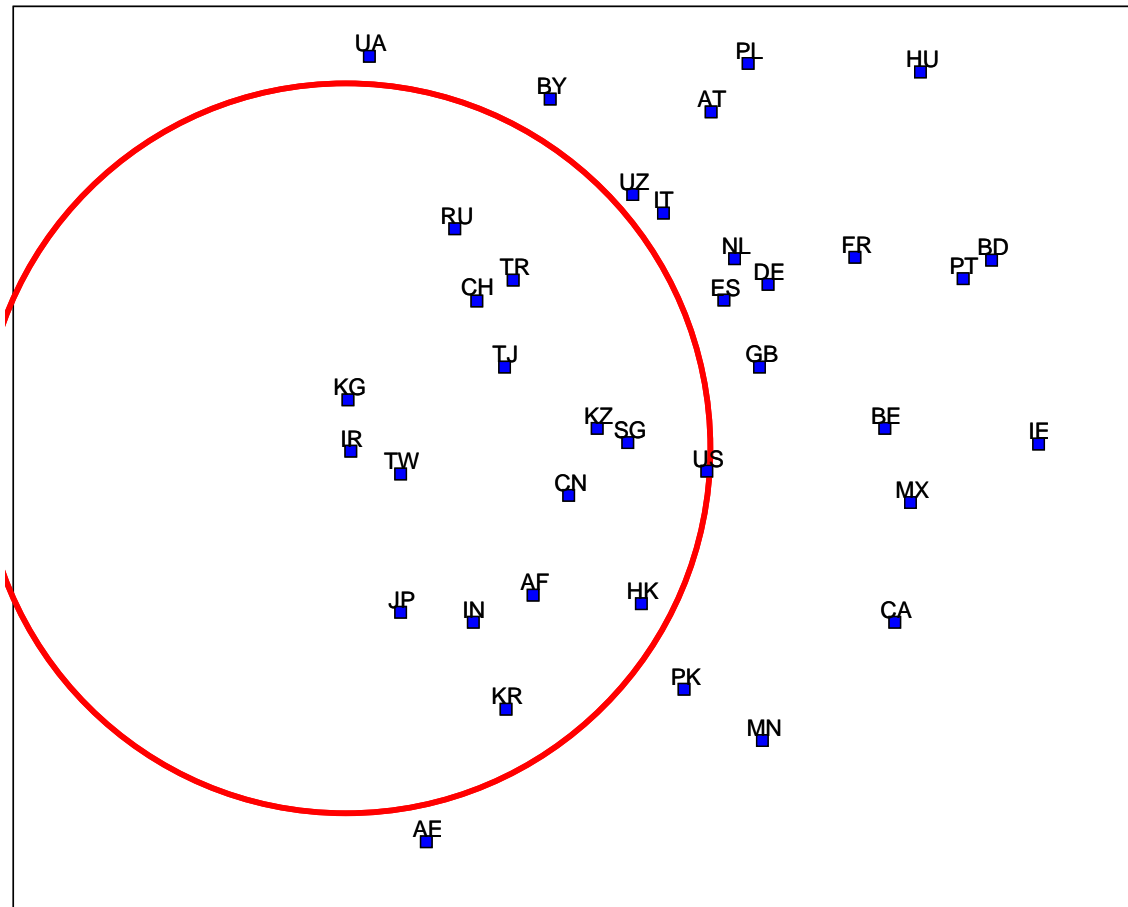
<sup>36</sup> Central Intelligence Agency, “The World Factbook: Imports – Partners.”

(NL) is relatively close. Iranian ties to both Italy and Germany have already been discussed. This projection can be explained by the interconnectedness of EU economies as would be expected given the formal structure of the EU with respect to trade, finance and economics.

Overall, the analysis of the imports data suggests that the US has very little unilateral capacity to influence Iran economically. The United States has a higher potential of negatively influencing both US economic partners and competitors globally, if sanctions were successful, as the economies of such countries are closer to that of Iran than that of the United States. These circumstances and their potential suggest that such an action by the US would have significant political consequences. Conversely, nothing in the results for imports suggested a strong interconnection between the American and Iranian economy which means that such economic actions aimed at Iran would be unlikely to have a significant adverse economic impact on the US. MDS has demonstrated the greatest levers economically lie with the SCO and EU. Iran has managed to put itself in a strong economic position by developing a relationship with both the SCO and EU, as the SCO and EU are themselves natural competitors economically. Before making any final conclusions; however, it is necessary to conduct similar analysis of the exports dataset.

## **Iranian Exports**

The data describing Iranian exports shall be examined in the same manner as Iranian imports using MDS.

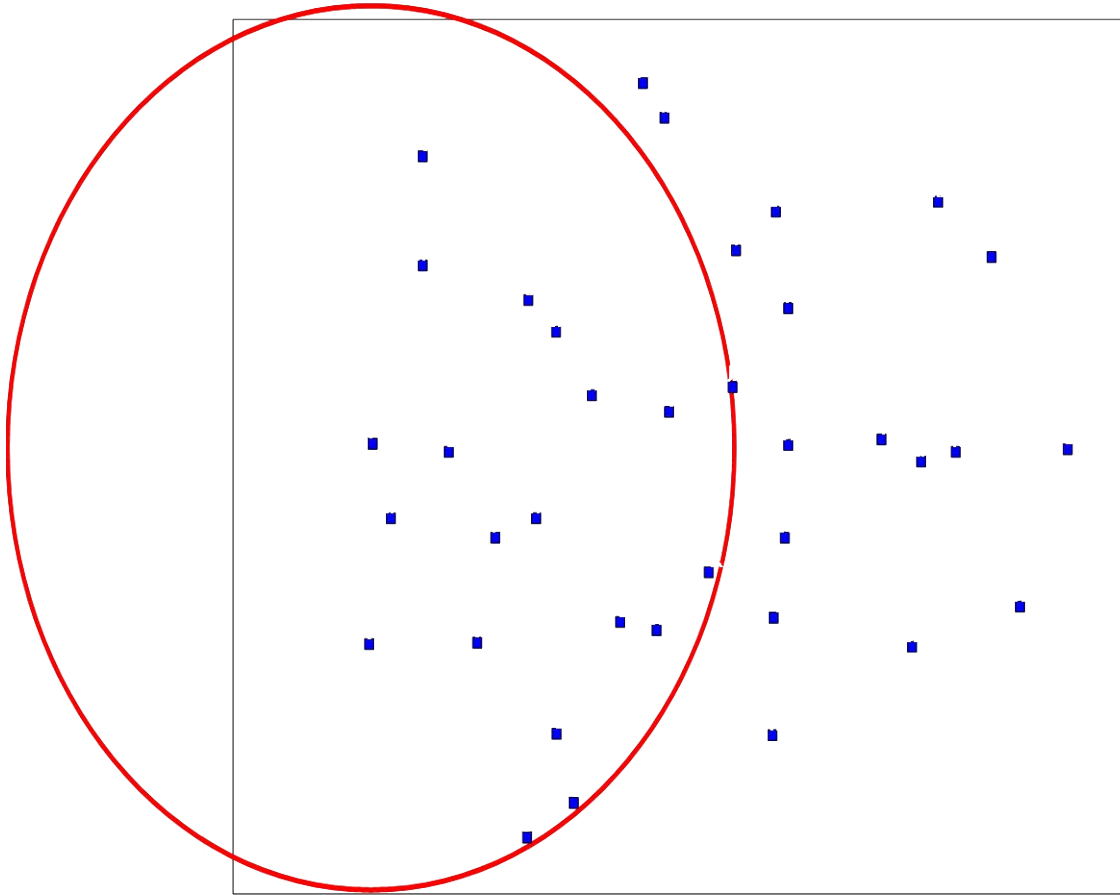


**Figure 4. First and second dimension of exports data**

Figure 4 shows the first two dimensions of the export MDS results. In this figure, Asian and Eurasian countries are closer to Iran than the US with Kyrgyzstan and Taiwan (TW) closest to Iran. Taiwan is drawn in as a consequence of its close ties with other Asian economies such as China, Hong Kong (HK), Japan (JP), South Korea and Singapore (SG), all well inside the threat ring. China accounts for 15%, Japan 14.3% and South Korea 7.3% of Iran's total exports, predominately consisting of petroleum



resources.<sup>37</sup> Kyrgyzstan, as before, is close to Iran as a result of the strong SCO representation inside the threat ring.



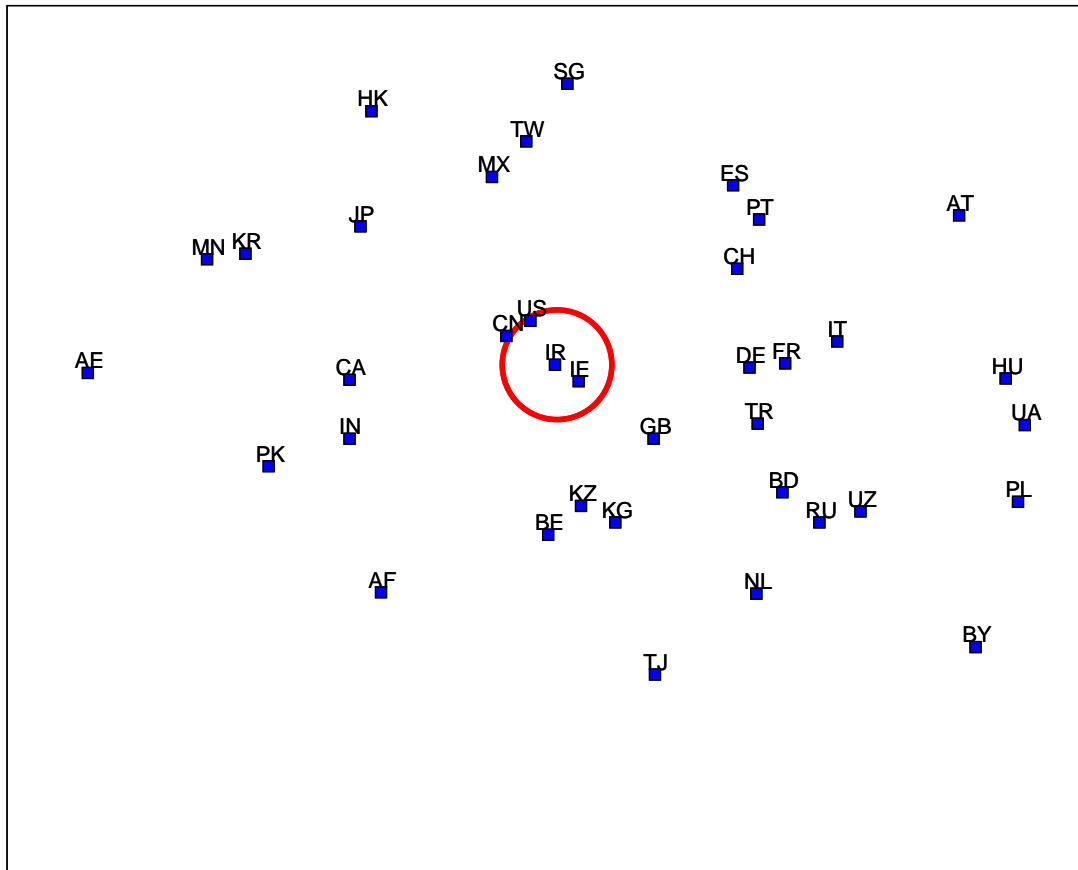
**Figure 5. First and third dimension of exports data**

Figure 5, representing the first and third dimension for exports, continues to demonstrate the same distant relationship between the United States and Iran. The closest countries to Iran are the United Arab Emirates (whose relationship has already been discussed in relation to the imports MDS results) and Ukraine. Ukrainian ties to Iran are not just via Russia as one might expect, but also Turkey (TR). Turkey accounts

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<sup>37</sup> Central Intelligence Agency, “The World Factbook: Exports – Partners.”

for 7.4% of Iranian total exports and 7.9% of Ukrainian total exports.<sup>38</sup> Turkey is the first non-EU NATO member to draw any attention in this study and notably lies well inside of the economic threat ring.



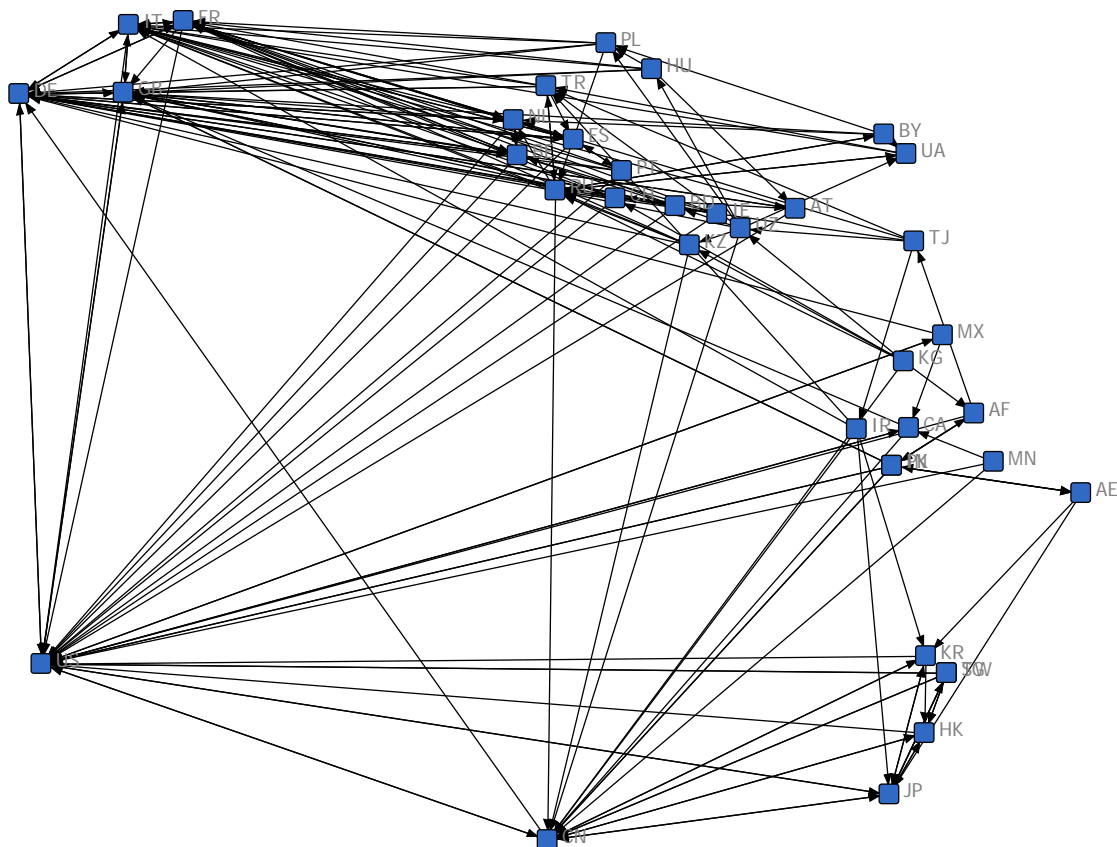
**Figure 6. Second and third dimension of exports data**

Figure 6 for the first time shows a close relationship between the US and Iranian economy. This is exciting in terms of representing an opportunity to exert direct influence; however, as the threat ring indicates there are very few buffer states inside the circle to protect the US economy from a backlash. This finding is a result of strong US and China ties. The United States accounts for 19.1% of Chinese total exports and China

<sup>38</sup> Central Intelligence Agency, “The World Factbook: Exports – Partners.”

accounts for 15% of total Iranian exports.<sup>39</sup> Ireland (IE) also appears close to Iran in the MDS results. This again demonstrates shared economic ties with other European countries trading with Iran, predominately Germany and France accounting for 7.4% and 5.8% of Ireland's exports respectively.<sup>40</sup> The relationship between Iran, Germany and France has already been discussed.

The significance of the American and Chinese economy to this system can be seen in the following graph also generated using UCINET on this dataset.



**Figure 7. Principle Component analysis of the export dataset**

Figure 7 was generated using principle component analysis on the exports dataset. Here the UCINET software is attempting to organize the graph into components that are

<sup>39</sup> Central Intelligence Agency, "The World Factbook: Exports – Partners."

<sup>40</sup> Central Intelligence Agency, "The World Factbook: Exports – Partners."

statistically significant. Just as in MDS, countries are grouped together on the basis of similar trade patterns. The US and China (CN) each are their own component indicating that they are economic superpowers in this system. In the upper left of the graph and tied more so to the US than China, major European economies of the United Kingdom, Germany, France and Italy form a component. In the lower right of the graph and tied strongly to both the US and China, the major Asian economies of Japan, South Korea, Taiwan and Hong Kong form a component. The remaining countries in the dataset do not appear to form distinct logical components, but instead have a myriad of ties to the US and China as well as the major economies of both Europe and Asia.

## **Hypothesis Testing**

Having completed the analysis of MDS results, it is now necessary to compare these results to the political strategies of the key actors related to Iranian trade. To demonstrate that economics influence international relations, countries who agree with US policy goals conceptually with respect to Iran and have strong ties to Iran economically would need to engage in political strategies which do not result in a negative economic impact upon themselves. If countries are willing to accept negative impacts on their own economy to pursue policy goals, then that serves to disprove this hypothesis.

As MDS results indicate, the member states of the EU and SCO represent those countries with the strongest economic ties to Iran. Therefore, the policy goals of these organizations and the specific countries identified as most significant within them shall be compared to US policy goals. For those countries found to share US policy goals, their political strategies will be examined in terms of their support of economic coercion

of Iran. This comparison shall demonstrate the strength of the hypothesis in this study and serve as an indicator of the possible success of such economic coercion of Iran.

First, it is necessary to establish in broad terms the policy goals with respect to Iran that the United States hopes to achieve through economic coercion. US foreign policy has been hostile toward Iran since the 1979 revolution and certainly in response to holding US embassy personnel in Tehran hostage shortly thereafter. Prior to the revolution, the US had good relations and engaged in trade with the Iranian regime of the Shah, as arguably a US proxy in the region. Such diplomatic and economic relations were severed as a result of the Iranian revolution and would have been naturally with or without the imposition of US sanctions.

US sanctions on Iran continue to this day. These sanctions are not imposed by the United Nations Security Council or any other multilateral organization or agreement. These sanctions are a result of Executive Orders of the President of the United States and Congressional legislation.<sup>41</sup> These sanctions relate to four main issues of concern: Iranian suspected pursuit of weapons of mass destruction including nuclear weapons, sponsorship of transnational terrorism, supporting violent opposition to the Middle East Peace Process, and Iran's domestic human rights violations.<sup>42</sup> US sanctions allow for limited commercial relations including Iranian food and medical imports from the US and food and carpet exports to the US.<sup>43</sup>

It has already been noted that these US sanctions have not received formal multilateral support. In the context of this research, the member states of the European

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<sup>41</sup> United States Department of State, "U.S.-Iranian Relations."

<sup>42</sup> United States Department of State, "U.S.-Iranian Relations."

<sup>43</sup> United States Department of State, "U.S.-Iranian Relations."

Union and Shanghai Cooperation Organization have the greatest capacity to influence Iranian economics. By the hypothesis posed in this study, these same countries should then be unlikely to support sanctions owing to the consequences on their own self-interest.

Examining EU policy on US sanctions is perhaps the most interesting to consider first because of the strong historical, cultural, economic and diplomatic ties between the US and the members of the EU. In a press release upon the renewal of the US *Iran and Libya Sanctions Act*, the EU Commissioner for External Relations released the following statement: “As a matter both of principle and policy, the European Union has long opposed unilateral sanctions laws with extraterritorial effects. Such laws, designed to impose US requirements on economic operations of foreign countries, threaten the open international trading system.”<sup>44</sup>

This same statement highlights EU policy making corporate compliance with these US sanctions illegal by any company in the EU.<sup>45</sup> This official statement by the EU notes that such actions by the US create expense for European countries and companies whether or not they comply with the sanctions and even threatens action against the US in the World Trade Organization should the US engage in any secondary boycotts or sanctions of European countries or companies owing to their non-compliance with US sanctions.<sup>46</sup>

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<sup>44</sup> European Union, “EU regrets extension of US sanctions law against Iran and Libya,” (accessed September 9, 2009); available from <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/01/1162&format=HTML&aged=0&language=EN&guiLanguage=en>; Internet.

<sup>45</sup> European Union, “EU regrets extension of US sanctions law against Iran and Libya.”

<sup>46</sup> European Union, “EU regrets extension of US sanctions law against Iran and Libya.”

Such strong policy and rhetoric emanating from the closest allies of the United States might represent strong disagreement with the issues the United States has with Iran; however, the very same EU statement concurs that the EU is concerned with Iranian weapons of mass destruction programs, sponsorship of terrorism and human rights violations.<sup>47</sup> Therefore, it seems reasonable to take this EU policy at face value to mean that the EU opposes these sanctions owing only to the economic self-interest of its member states.

Germany, France and Italy are not only some of the strongest economic powers within the EU, but they are also those most strongly tied to Iran based on the results of this study. The alignment of EU policy to economics over diplomatic ties to the US supports the underlying hypothesis that economics constrains international relations and that such tendency can be quantified by empirical measurement.

The member states of the SCO were next identified as those most capable of exerting influence over the Iranian economy. SCO policy shows a similar dominance of economics in international relations as found in the case of EU member countries. Setting the stage for this analysis, it is most easy to understand that Iran has observer status in the SCO where the US lacks such status and key members of the SCO, Russia and China, are historically global competitors with the US. Thus, unlike the members of the EU, the members of the SCO except perhaps India do not have a long history of close friendly ties to the US. Even India has previously grossly defied US policy initiatives in terms of its own development of nuclear weapons.

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<sup>47</sup> European Union, "EU regrets extension of US sanctions law against Iran and Libya."

SCO focus areas are: multi-polar emergence to compete with US global hegemony, energy sector economic development, and regional security cooperation.<sup>48</sup> Central to the SCO strategy is what many are metaphorically calling the New Great Game.<sup>49</sup> The New Great Game (NGG) represents competition between the world's greatest powers (US, Russia, China and India) for influence in Central Asia and is predominately, but not entirely, tied to the exploitation of oil reserves. US interest in these oil reserves is two-fold. First, much of this oil has the potential to be exported to Western Europe, including the United States' closest allies in the EU and NATO. The US has an interest in supporting the goals and advancement of its allies. Second, as oil is a fungible commodity, increased global supply can be expected to reduce prices for all oil consumers from all suppliers. As the world largest oil consumer, the US has an interest in lowering the price of oil.

Within the SCO, Russia, Uzbekistan and Pakistan are the countries with the strongest economic ties to Iran according to the results of this study. Iran is a pivot point in the NGG physically, economically, and ideologically residing between the great powers of the East and West. While Iran's westward looking policies appear to the West to be roguish and radical, Iran's eastward looking behavior predominately consists of the rational economic and trade relationships previously noted in this study.

Friction between Russia and Pakistan is growing as the NGG emerges because Russia has chosen to support India's full membership in the SCO in order to form a

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<sup>48</sup> Charles Hawkins and Robert R. Love, *The New Great Game*, (Fort Leavenworth, KS: Foreign Military Studies Office, 2006), 1-2, 47, 171-172.

<sup>49</sup> Hawkins, 1.



powerful bloc to compete with China.<sup>50</sup> In exchange, Russia is expected to support India's desire for the exclusion of Pakistan from full membership in the SCO. This naturally forces Pakistan to seek to cooperate with China. Iran has long cooperated with the ideologically sympathetic countries of Pakistan and Uzbekistan, as seen in the economic data used here; therefore, Russia's desire to consolidate power is likely to move Iran closer to China while perhaps still maintaining its economic ties to Russia.

While the US and China are competitors in Central Asia and in the NGG paradigm, globally the American economy is strongly tied to the Chinese economy as already discussed. Notably, the United States is also heavily reliant on Pakistan as a logistical supply route for US and NATO military forces in Afghanistan and combating terrorism inside the borders of Pakistan. These ties and the emergent behavior in the context of NGG and related to the growth of the SCO again place Iran at center of this problem.

Whether Iran is a mere pawn in the New Great Game, a power broker between the East and West, or simply a large importing and exporting economy relative to other lesser developed countries in the region; it is clear that none of the member states of the SCO can afford to damage their diplomatic or economic relations with Iran without considering the consequences for their own economy. Few members of the SCO have any strong sympathetic reason to support US sanctions on Iran. Therefore, it is not surprising that economic and policy decisions of the SCO also support the hypothesis that international relations in this context are constrained by economics.

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<sup>50</sup> Hawkins, 11.

While the case of the EU, SCO and leading member states of these organizations supports the hypothesis of this research, a potential bias is that this situation is not by accident. Iran has had roughly 30 years, from 1979 to today, to craft a strategy to undermine US sanctions by exploiting the globalized economy, Iran's advantageous geographical location, and global reliance on natural resources available in Iran. This and other biases previously mentioned constrain the case of Iran to a proof-of-concept admitting that there are many factors other than economics which are potentially causal in the emergence of these conditions. This case, however, serves to demonstrate that irrelevant of such potential factors, it is possible to identify and quantify the existence of these conditions using the methodology defined and tested in this study based solely upon empirical analysis of balance of trade data.

Herein lies the limits of such techniques, identification and analysis of empirical results only provide increased understanding of the context of the problem. Without more detailed contextual analysis it is not possible to determine the best course of action to achieve policy aims given this increased understanding of the problem. To this end, discussion of the foundation of such sanctions and alternatives are addressed in the following section.

## **Context of US-Iran Sanctions**

Previously in this monograph, the US issues of concern with the Iranian regime have been articulated and the hostile environment surrounding US-Iran relations following the 1979 revolution have been touched on. However, none of this history explains why sanctions were chosen over other approaches to resolving this conflict.

Meghan O’Sullivan of the Brookings Institute makes the case that the US engaged in unilateral sanctions owing predominately to domestic issues rather than the truly shared interests of the international community with respect to Iran’s weapon programs, sponsorship of terrorism, and human rights violations.<sup>51</sup> As previously noted, the international community shares these concerns; however, does not share the American zeal for sanctions.

O’Sullivan notes in part that there is distrust of US intentions owing to legitimate Iranian claims of US meddling in Iranian affairs historically and American pro-Israeli leanings in the context of the Middle East Peace Process.<sup>52</sup> Further, Iran received no lenience from the US after its neutral stance in the Gulf War and support of the current war in Afghanistan toppling the Taliban regime.<sup>53</sup> In fact, O’Sullivan goes further arguing that while US sanctions have done little to modify Iranian behavior and have to some degree alienated US allies in the EU and elsewhere, if anything sanctions ensure a stalemate in US-Iranian relations.<sup>54</sup>

The maintenance of internationally unpopular and arguably ineffective unilateral US sanctions is attributed to the lobbying efforts of the American Israel Political Affairs Committee (AIPAC).<sup>55</sup> The interests of AIPAC are by definition a convolution of those of the United States and Israel arguably to the neglect of broader US interests. The Brookings’ Institute estimates that between the years of 1995 and 2001, these sanctions

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<sup>51</sup> O’Sullivan, 54.

<sup>52</sup> O’Sullivan, 45.

<sup>53</sup> O’Sullivan, 45.

<sup>54</sup> O’Sullivan, 47.

<sup>55</sup> O’Sullivan, 54.

have cost Iran \$4.4 billion while simultaneously costing the US \$1.9 billion.<sup>56</sup> Whether or not one agrees with the argument posed by the Brookings Institute entirely or the ideological aspirations of AIPAC, the fact that AIPAC remains a powerful lobby affecting US decision making related to Iran cannot be neglected in considering alternatives to sanctions.

Ken Pollack who served on the National Security Council and prior to that as an Iran analyst at the Central Intelligence Agency in both the Clinton and Bush Administrations proposes such a set of alternatives in his book, *The Persian Puzzle*.<sup>57</sup> Specifically, Pollack proposes the following alternative policies: (1) unilateral concessions, (2) the grand bargain, and a (3) triple track approach.<sup>58</sup>

The unilateral concessions alternative argues for lifting US sanctions with the aim of encouraging peaceful, democratic regime change in Iran leading to the election of moderate leaders less desirous of pursuing nuclear weapons, sponsoring terrorism and violating human rights.<sup>59</sup> The grand bargain alternative involves negotiating all of the issues of concern between Iran and the US simultaneously with the existing Iranian regime in exchange for normalized, if not favorable, relations as the immediate result.<sup>60</sup> Pollack for relatively obvious reasons does not favor either of these alternatives, but rather favors a hybrid approach he calls the triple track approach.

The triple track approach keeps the option for the grand bargain on the table should sufficient progress be made toward conflict resolution; applies carrots and sticks

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<sup>56</sup> O'Sullivan, 101-102.

<sup>57</sup> Kenneth M. Pollack, *The Persian Puzzle*, (New York, NY: Random House, 2005).

<sup>58</sup> Pollack, 390,395,400.

<sup>59</sup> Pollack, 390.

<sup>60</sup> Pollack, 395.

to progress in meeting agreed upon milestones in terms of nuclear weapons, sponsorship of terrorism and human rights; and maintains the option for the US to fall back to a new containment policy targeting Iran.<sup>61</sup> The premise being that this new containment policy, perhaps even multilateral sanctions, would receive international support unlike current US sanctions, if the US has shown good faith in attempting to resolve its conflicts with Iran.

It is too early to determine to what degree the Obama Administration's approach to its renewed interest in conflict resolution with Iran takes advantage of these insights; however, what is clear is that maintaining the US regime of sanctions is likely to continue to have the same relatively insignificant positive influence on Iran. It is not clear that analysts, such as Pollack, have considered the influence of economics on international relations in terms of gaining international support. Likewise, consideration limited to such empirical research neglects the emotional component raised by O'Sullivan in the context of AIPAC sympathy to the state of Israel affecting US foreign policy.

## **Conclusions**

Using Iran as a case study, this monograph has demonstrated the viability of the concept of economic threat rings as developed here using MDS as a tool to quantify the degree to which the interconnectedness of global trade constrains international relations. While such quantitative methods applied to balance of trade data appear useful in gaining improved understanding of the underlying complexities of the global economic system, there remains a clearly articulated need for additional qualitative and contextual analysis

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<sup>61</sup> Pollack, 401, 405, 412.

as well. Analysis of empirical data does not provide answers as to causality nor does it provide prescriptions for intervening courses of action.

In this monograph, some of these sources of bias and context have been discussed such as domestic policy and historical legacies; however, many other sources of bias likely exist in any given case study. Qualitative analysis regarding the relationship between economics and international relations has been discussed in the context of Iran. Alternative policy options have been presented. What is perhaps most valuable is the gained understanding that the most viable policies are likely those that account for the observed behavior both quantitatively and qualitatively.

Volumes have been written on the qualitative aspects of international relations over generations perhaps starting with Plato's *Republic*; however, less intellectual effort has been expended examining the quantitative aspects presented in this monograph. Therefore, the greatest contribution of this work rests in the development and application of the economic threat ring methodology. While the analytic technique applied (Multi-Dimensional Scaling) is not a new mathematical technique, the application to balance of trade as a tool for gaining insight into the propensity and potential of nation state actors in the complex global economic system is new. Most important to the proper application of this technique is selection of the countries to include in sample datasets based on international relations, the selection of the indicator variable as percentage versus raw monetary value, and understanding how to apply theoretical selection criteria to analytical issues such as dimensionality and thresholds on stress.

The utility of such techniques shall endure not simply owing to continued US interest with Iran as in this case study, but as a result of the enduring fact of economics as

an instrument of national power affecting international relations. As globalization increases the interconnectedness of national economies around the world, transnational trade relationships shall offer both increased risk and opportunity in the pursuit of national objectives. While this interconnectedness potentially enables international coalition building based upon common economic interest, such interconnectedness potentially deters, moderates, and constrains nations from actions, which would negatively affect their economy. The growing complexity of this paradox will challenge decision makers in new ways requiring the application of new tools such as those presented in this monograph.

## Appendix A

### International Organization for Standardization country codes

AFGHANISTAN	AF	CHILE	CL
ÅLAND ISLANDS	AX	CHINA	CN
ALBANIA	AL	CHRISTMAS ISLAND	CX
ALGERIA	DZ	COCOS (KEELING) ISLANDS	CC
AMERICAN SAMOA	AS	COLOMBIA	CO
ANDORRA	AD	COMOROS	KM
ANGOLA	AO	CONGO	CG
ANGUILLA	AI	CONGO	CD
ANTARCTICA	AQ	COOK ISLANDS	CK
ANTIGUA AND BARBUDA	AG	COSTA RICA	CR
ARGENTINA	AR	CÔTE D'IVOIRE	CI
ARMENIA	AM	CROATIA	HR
ARUBA	AW	CUBA	CU
AUSTRALIA	AU	CYPRUS	CY
AUSTRIA	AT	CZECH REPUBLIC	CZ
AZERBAIJAN	AZ	DENMARK	DK
BAHAMAS	BS	DJIBOUTI	DJ
BAHRAIN	BH	DOMINICA	DM
BANGLADESH	BD	DOMINICAN REPUBLIC	DO
BARBADOS	BB	ECUADOR	EC
BELARUS	BY	EGYPT	EG
BELGIUM	BE	EL SALVADOR	SV
BELIZE	BZ	EQUATORIAL GUINEA	GQ
BENIN	BJ	ERITREA	ER
BERMUDA	BM	ESTONIA	EE
BHUTAN	BT	ETHIOPIA	ET
BOLIVIA	BO	FALKLAND ISLANDS	FK
BOSNIA AND HERZEGOVINA	BA	FAROE ISLANDS	FO
BOTSWANA	BW	FIJI	FJ
BOUVET ISLAND	BV	FINLAND	FI
BRAZIL	BR	FRANCE	FR
BRITISH INDIAN OCEAN	IO	FRENCH GUIANA	GF
BRUNEI DARUSSALAM	BN	FRENCH POLYNESIA	PF
BULGARIA	BG	FRENCH SOUTHERN TERR.	TF
BURKINA FASO	BF	GABON	GA
BURUNDI	BI	GAMBIA	GM
CAMBODIA	KH	GEORGIA	GE
CAMEROON	CM	GERMANY	DE
CANADA	CA	GHANA	GH
CAPE VERDE	CV	GIBRALTAR	GI
CAYMAN ISLANDS	KY	GREECE	GR
CENTRAL AFRICAN REPUBLIC	CF	GREENLAND	GL
CHAD	TD	GRENADA	GD



GUADELOUPE	GP	MALAYSIA	MY
GUAM	GU	MALDIVES	MV
GUATEMALA	GT	MALI	ML
GUERNSEY	GG	MALTA	MT
GUINEA	GN	MARSHALL ISLANDS	MH
GUINEA-BISSAU	GW	MARTINIQUE	MQ
GUYANA	GY	MAURITANIA	MR
HAITI	HT	MAURITIUS	MU
HEARD AND MCDONALD IS.	HM	MAYOTTE	YT
HOLY SEE (VATICAN)	VA	MEXICO	MX
HONDURAS	HN	MICRONESIA	FM
HONG KONG	HK	MOLDOVA	MD
HUNGARY	HU	MONACO	MC
ICELAND	IS	MONGOLIA	MN
INDIA	IN	MONTENEGRO	ME
INDONESIA	ID	MONTSERRAT	MS
IRAN	IR	MOROCCO	MA
IRAQ	IQ	MOZAMBIQUE	MZ
IRELAND	IE	MYANMAR	MM
ISLE OF MAN	IM	NAMIBIA	NA
ISRAEL	IL	NAURU	NR
ITALY	IT	NEPAL	NP
JAMAICA	JM	NETHERLANDS	NL
JAPAN	JP	NETHERLANDS ANTILLES	AN
JERSEY	JE	NEW CALEDONIA	NC
JORDAN	JO	NEW ZEALAND	NZ
KAZAKHSTAN	KZ	NICARAGUA	NI
KENYA	KE	NIGER	NE
KIRIBATI	KI	NIGERIA	NG
KOREA, NORTH	KP	NIUE	NU
KOREA, SOUTH	KR	NORFOLK ISLAND	NF
KUWAIT	KW	NORTHERN MARIANA IS.	MP
KYRGYZSTAN	KG	NORWAY	NO
LAO REPUBLIC	LA	OMAN	OM
LATVIA	LV	PAKISTAN	PK
LEBANON	LB	PALAU	PW
LESOTHO	LS	PALESTINIAN TERRITORIES	PS
LIBERIA	LR	PANAMA	PA
LIBYA	LY	PAPUA NEW GUINEA	PG
LIECHTENSTEIN	LI	PARAGUAY	PY
LITHUANIA	LT	PERU	PE
LUXEMBOURG	LU	PHILIPPINES	PH
MACAO	MO	PITCAIRN	PN
MACEDONIA	MK	POLAND	PL
MADAGASCAR	MG	PORTUGAL	PT
MALAWI	MW	PUERTO RICO	PR

QATAR	QA	SWITZERLAND	CH
RÉUNION	RE	SYRIAN ARAB REPUBLIC	SY
ROMANIA	RO	TAIWAN	TW
RUSSIAN FEDERATION	RU	TAJIKISTAN	TJ
RWANDA	RW	TANZANIA	TZ
SAINT BARTHÉLEMY	BL	THAILAND	TH
SAINT HELENA	SH	TIMOR-LESTE	TL
SAINT KITTS AND NEVIS	KN	TOGO	TG
SAINT LUCIA	LC	TOKELAU	TK
SAINT MARTIN	MF	TONGA	TO
SAINT PIERRE-MIQUELON	PM	TRINIDAD AND TOBAGO	TT
SAINT VINCENT-GRENADINES	VC	TUNISIA	TN
SAMOA	WS	TURKEY	TR
SAN MARINO	SM	TURKMENISTAN	TM
SÃO TOMÉ AND PRÍNCIPE	ST	TURKS AND CAICOS ISLANDS	TC
SAUDI ARABIA	SA	TUVALU	TV
SENEGAL	SN	UGANDA	UG
SERBIA	RS	UKRAINE	UA
SEYCHELLES	SC	UNITED ARAB EMIRATES	AE
SIERRA LEONE	SL	UNITED KINGDOM	GB
SINGAPORE	SG	UNITED STATES	US
SLOVAKIA	SK	URUGUAY	UY
SLOVENIA	SI	UZBEKISTAN	UZ
SOLOMON ISLANDS	SB	VANUATU	VU
SOMALIA	SO	VENEZUELA	VE
SOUTH AFRICA	ZA	VIET NAM	VN
SOUTH GEORGIA	GS	VIRGIN ISLANDS, BRITISH	VG
SPAIN	ES	VIRGIN ISLANDS, US	VI
SRI LANKA	LK	WALLIS AND FUTUNA	WF
SUDAN	SD	WESTERN SAHARA	EH
SURINAME	SR	YEMEN	YE
SVALBARD AND JAN MAYEN	SJ	ZAMBIA	ZM
SWAZILAND	SZ	ZIMBABWE	ZW
SWEDEN	SE		

# Appendix B

## Iranian Trade Data

### Imports

	FROM																																			
	AE	AT	BE	BY	CA	CN	DE	ES	FR	GB	IN	IR	IT	JP	KG	KR		KZ	MN	NL	PK	RU	SA	TJ	TW	UA	US	UZ	MX	CH	IE	AU	ID	SG	KW	NO
TO	AE	0				13	5.9				5.3	10	4.6	6.1						4.3					8.7											
	AT		0				4.6						7.1							18										5						
	BE			0		4.1	18			11	6.2															5.4					4.9					
	BY				0		7.6														60															
	CA					0	9.4																													
	CN						0	4.7						14		11																				
	DE	4.4	7.8				6.2	0		8.6	5.6			5.8					12																	
	ES						5.8	16	0	13	4.8			8.4					4.6																	
	FR			11			4	19	7.1	0	5.6			8.4					7																	
	GB			4.7			7.3	14		6.9	0			4.2					7.3																	4.7
	IN						11	4.4				0																								4.4
	IR	9.1					14	9.6					0	5			6.3				5.7															
	IT			4.3			5.9	17	4.2	9				0					5.5																	
	JP						21								0	4.4																		5	4.2	
	KG						15									0		13																		
	KR						18							16		0																				
KZ						22	8										0				35															
MN						32							7.2		7.9		0				29															
NL						11	18		4.4	5.8								0																		
PK						16							4.4								0	11													4.9	
RU				4.4		12	13						4.3	6.4		4.4						0														
SA						9.4	8.8			4.5			5	8.1		4.9							0													
TJ						11											13				32		0													
TW						13							19			5.5							6.3	0												
UA						13	5.9			5.3	10		4.6	6.1																						
US						16	17	4.8					7.4																							
UZ						13	6.3										13	6.2			30															
MX						11							5.8			4.5																				
CH	4.2					33			9.5	4.2			11					4.6																		
IE						9.7			4.2	3.8								5																		
AU						16	5.2				4.3				9.6																					
ID						12							8.8			4.3						4.5														
SG						12							8.2			4.9																				
KW						6.8	7.3				4.6		5.8	8.5		6.6						6.2														
NO						4.3	6.1	14			6.9																									

## Exports

	TO																																						
	IR	AT	BE	BY	CA	CN	DE	ES	FR	GB	HK	IE	IN	IT	JP	KG	KR	KZ	MN	MX	NL	PK	PT	RU	SG	TJ	TR	TW	UA	US	UZ	CH	PL	AE	AF	HU	BD		
FROM	IR	0				15								6.4	14		7.3										7.4												
	AT		0				30							8.8																	4.9		4.3						
	BE			0				20	17	7.6				5.2					12												5.7								
	BY				0					6.3									18					37					6.1					5					
	CA					0	2.1			2.8																													
	CN						0	4			15					8.4	4.6																	19					
	DE		5.4	5.3				0	5	9.7	7.3				6.7					6.4														7.5					
	ES						11	0	19	7.6					8.5							8.6												4.2					
	FR			7.3			15	9.3	0	8.1					8.9					4.1														6.1					
	GB				5.3			11	4.5	0					4.1																					14			
	HK					49					0				4.5																				14				
	IE			15			7.4	5.8	19		0																								18				
	IN					8.7			4.4			0																							15		8.7		
	IT						13	7.4	11	5.8			0																						6.8				
	JP					15					5.4					0	7.6											6.3				20							
	KG					5.5										0	18							21							7.6	20				10			
	KR					22					5				7.1		0																12						
	KZ					16	12		6.7						7.2		0								11														
	MN					11	72										0																		4.8				
	MX					2.4		1.5												0																			
	NL			14			24		8.5	9.1				5.1					0																	82			
	PK						5.2			4.7											0														18		10	8.4	
	PT							13	27	12	5.9			4								0													4.8				
	RU			5		4.5	7.5							7.8		4.8					12		0					5.2		4.7									
	SG					9.7					11																							8.9					
	TJ	5.1																			39		6.6		0			0	33					5.9					
	TR					29		11	4.3	5.6	8.1			7																									
	TW										9.8					6.9																							
	UA														5.8								23				4.6		0		12								
	US					21	5.6	4.3			4.3					5.4				12																			
	UZ					5.6												6.1																0					
	CH						20		8.4	5.1				8.7																									
	PL						26		6.1	5.9				6.6																									
	AE												4.8			24		9.2																		0			
	AF												23									22														0			
	HU	4.6		4				28		4.7	4.5			5.6																						0			
BD							13		5.5	9.1																										0			

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